TM 3-325

WAR DEPARTMENT

TECHNICAL MANUAL

LIVENS PROJECTOR MI

August 21, 1942

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No. 3–325

WAR DEPARTMENT,
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LIVENS PROJECTOR MI

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SECTION I

GENERAL

1. Purpose and scope.—This manual is intended for the using services. It gives all necessary information about the construction, function, and identification of all standard matériel pertaining to the Livens projector MI assembly, with directions for shipping and storage.

2. References.—See appendix.

SECTION II

DESCRIPTION AND DATA

3. General.—*a. Weapon.*—Livens projector MI (fig. 1) is a weapon of limited range and mobility but of high chemical efficiency. It consists essentially of a steel barrel, a steel base plate, and a canvas muzzle cover. Accessories are required for laying out and digging the emplacement, for wiring the battery and testing the circuit, and for firing the battery.

(1) *Range.*—Maximum range is 1,450 yards; minimum, 910 yards with the present standard propellant. The range is varied by regulating the propelling charge.

(2) *Angle of fire.*—The projector is fired at a constant angle of elevation (45° or 800 mils). The angle of fire permits firing from a trench or behind cover, as well as engaging targets that are defiladed, as on reverse slopes or in ravines.

(3) *Efficiency.*—A filled shell weighs approximately 61 pounds and has a chemical efficiency of approximately 47 percent. The high chemical content of the shell permits a more rapid delivery of agent upon the target, and in higher concentrations, thereby obtaining greater surprise than with any other ground weapon. In this respect the Livens projector is the most effective chemical weapon known for nonpersistent agent, and the highest state of protective training and discipline is required to meet a Livens projector attack successfully. Besides producing a cloud of greater concentration and with greater surprise, it is less dependent upon wind, weather, and terrain conditions than are chemical cylinders.

(4) *Dispersion.*—For ranges between 1,000 and 1,450 yards, the range probable error of a battery of 25 projectors is approximately 25 yards and the deflection probable error, 35 yards. Approximately 96 percent of all shots fired will fall within an area 225 yards front by 150 yards deep, while 67 percent will fall within an area 150 yards front by 100 yards deep when the entire battery is sighted on a single aiming point.

(5) *Functioning.*—All Livens projectors in the same battery are fired simultaneously by means of an electric blasting machine.

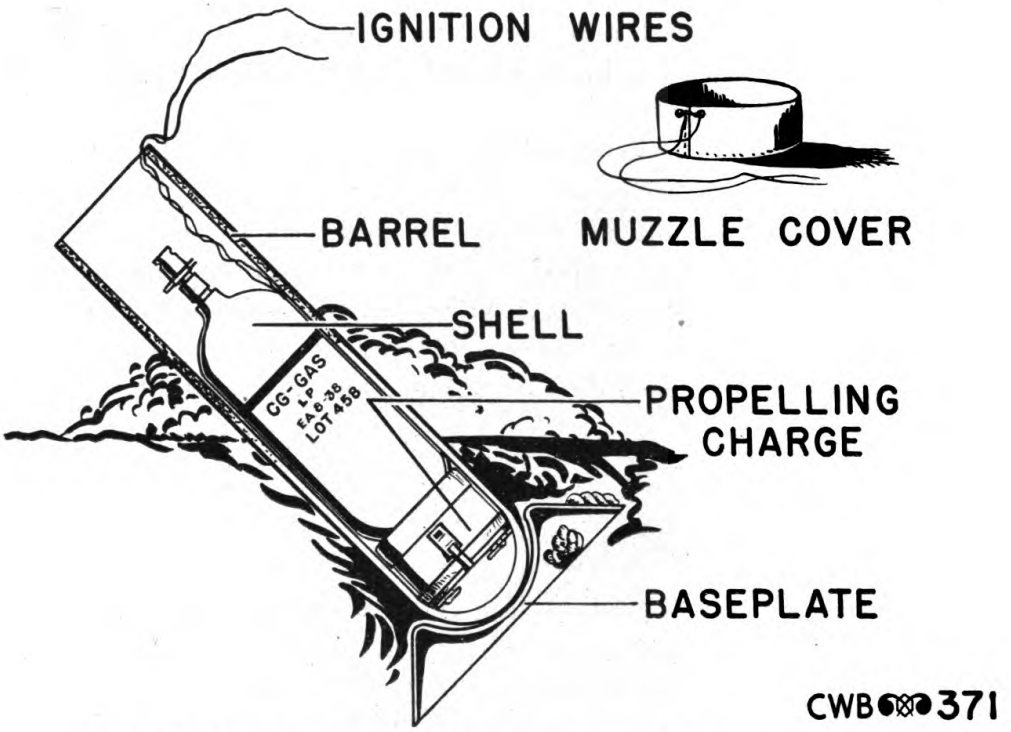

FIGURE 1.—Diagrammatic sketch, main components, Livens projector MI.

b. Ammunition.—(1) *Fillings.*—Standard ammunition for the Livens projector consists of only two types, gas shell and smoke shell. Chemical fillings that are authorized are the nonpersistent gas, phosgene (CG), for use in the theater of operations, and the smoke mixture, sulfur trioxide-chlorsulfonic acid (FS), for use in the zone of the interior and for training purposes only. Limited standard fillings are chlorine (Cl) as nonpersistent gas and titanium tetrachloride (FM) as smoke.

(2) *Complete round.*—A complete round of ammunition consists of the following components: filled shell, loaded burster-tube assembly, fuze assembly, and propelling-charge assembly. The components of a complete round are not assembled until just before the shell is to be fired.

(3) *Weights.*—Approximate weights of the components of a complete round are as follows:

Shell, body, MII or MIIA1	pounds	33
Shell finding, CG or FS	do	28
Burster tube MI assembly	do	2
Fuze MI assembly	ounce	½
Propelling charge MIII, assembly	pounds	8 11/16

4. Detailed description.—*a. Barrel MI.*—(1) *Construction.*—The barrel MI of the Livens projector is a drawn steel tube closed and rounded at one end and open at the other. It has a bore of 7.875–8.00 inches, wall thickness of 0.344–0.406 inch, a length of 37.5 inches, and weighs 104 pounds.

(2) *Protection.*—The inside of the barrel is coated with a rust-preventive compound; the exterior, with one coat of acidproof black paint.

(3) *Marking.*—The muzzle end is stamped with the mark number, the manufacturer's name or trade-mark, and the date of manufacture.

b. Base plate MI (fig. 2).—(1) *Construction.*—The base plate is rectangular with the shorter sides rounded. It is made from ¼-inch pressed steel and has the following dimensions and weight:

Width	inches	12½
Length	do	19¼
Height	do	4½
Weight	pounds	28

It has a rounded central depression, 10½ inches in diameter and 3⅞ inches deep, into which the butt of the barrel fits when the projector is assembled. The edges of the base plate are crimped on all sides.

(2) *Handle.*—Two ¾-inch holes are drilled in one end of a short side, a section of ½-inch manila rope is passed through the holes, and double overhand knots tied in each end, the knots coming on the under side of the base plate. This rope serves as a handle.

(3) *Protection.*—The surface of the base plate is covered with one coat of acidproof black paint.

c. Muzzle cover MI.—The muzzle cover is made of waterproof 4-ounce olive-drab duck. It has the following dimensions and weight:

Diameter	inches	9
Height	do	4
Weight	ounces	6½

It is provided with a cord run through the rim so that the cover can be tied over the muzzle end of the barrel to keep out dirt and moisture.

SECTION III

AMMUNITION

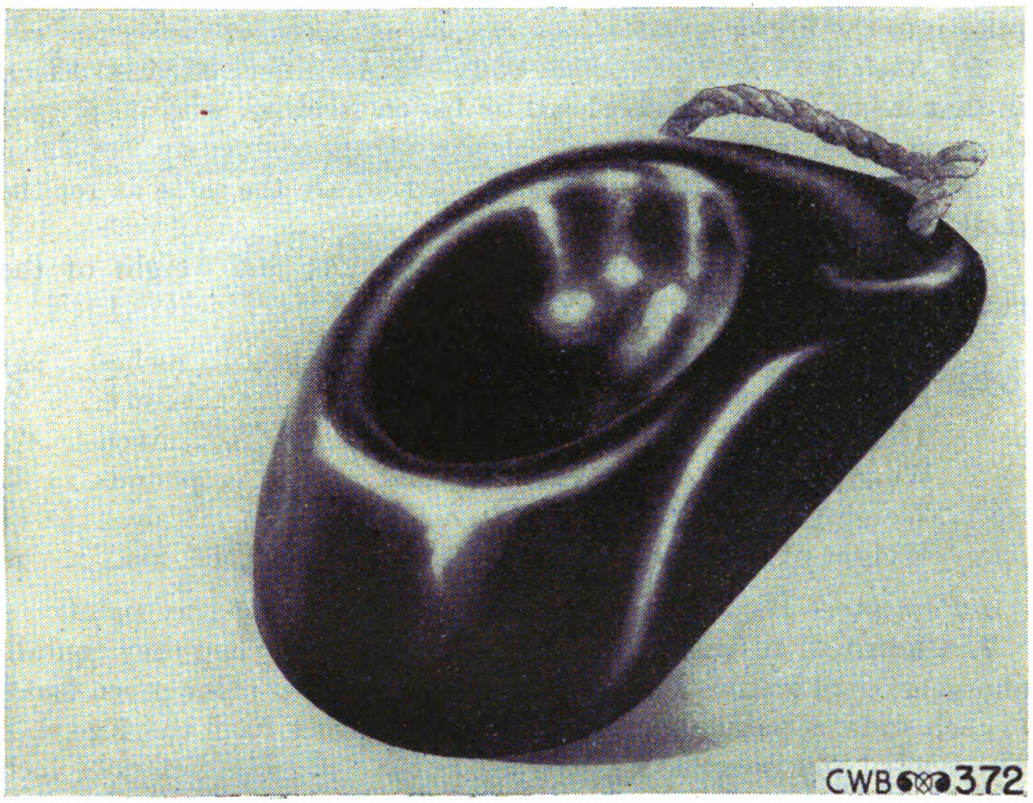

FIGURE 2.—Base plate MI for Livens projector.

5. General.—The Livens projector has a smooth bore, consequently the shell is unstable in flight and may strike the ground in any position. In order that the shell may function, a fuze assembly consisting of a primer, a 12-inch section of type III safety fuze, and a detonator is used in the burster-tube assembly to set off the burster charge.

6. Shell body.—*a. Construction.*—Two types of shell bodies are used in the Livens projector, differing slightly in construction. They are designated the MII and the MIIA1.

(1) *Shell body MII* (figs. 3 and 4).—Shell body MII is made of seamless drawn steel tubing 3/16-inch thick with forge-welded ends. It can be identified by the projections at each end, which are 1.69 inches in diameter and approximately 1 inch long. The shell has a capacity of approximately 660 cubic inches. A central tube runs the length of the shell and is welded into it at both ends. A steel plug (coupling plug) is welded into the tube to divide it into the section used to receive the burster tube and the section used for filling the shell. The shell filling passes from the tube into the shell through four holes located near the filling end of the shell. There are also two vent holes. After filling, the shell is sealed by screwing a tapered plug into the filling hole.

(2) *Shell body MIIA1.*—Shell body MIIA1 differs in construction in that it has rounded ends closed by fusion welding, with no projections on either end. It has a capacity of approximately 716 cubic inches. The other details of its construction are the same as for the shell body MII.

b. Dimensions.—The approximate dimensions and weight of the two types are:

Outside diameter	inches	7¾
Length over-all	do	23
Thickness of side wall	inch	3/16
Weight, empty	pounds	33
Weight, filled (CG or FS)	do	61
Weight of filling (CG or FS)	do	28

c. Painting.—Both types are given one coat of blue-gray paint.

7. Chemical fillings (fig. 5).—*a. Gas shell.*—When they contain phosgene, shell are marked in the following manner: One green band, ½ inch wide, is painted around the shell, 8 inches from the fuze end. The symbol and word "CG–GAS" are painted in green letters ¾ inch high and ¼ inch below the green band. One-fourth inch under this are stenciled the letters "LP," ½ inch high. At the same distance and in letters of the same size, loader's identification mark and date are stenciled. Immediately below this is the lot number.

b. Smoke shell, FS.—The smoke shell is marked in the same manner as the gas shell except that yellow paint is used instead of green and the symbol and word "FS—SMOKE" appear.

8. Fuze MI assembly (fig. 6).—*a. General.*—The fuze assembly is used to set off the burster charge which ruptures the shell after it has been fired.

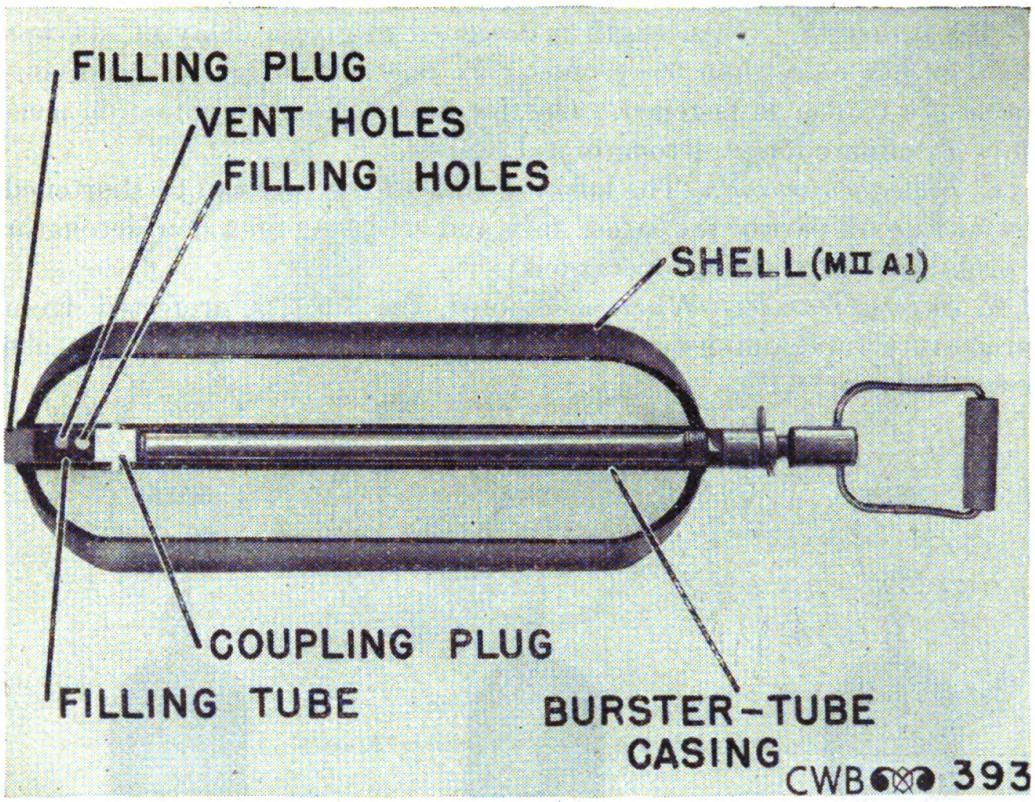

FIGURE 3.—Diagrammatic cross section of Livens shell.

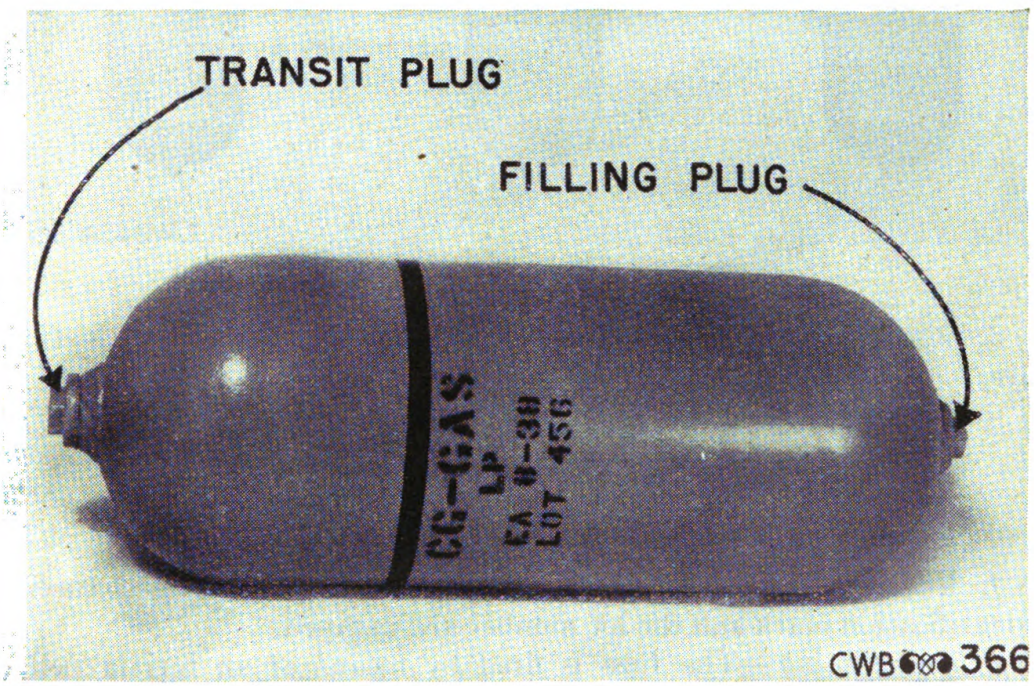

FIGURE 4.—Shell body MII, showing markings.

b. Construction.—It consists of a piece of type III safety fuze 12 inches in length. This length is designed to give a delay of not less than 30 nor more than 36 seconds. To one end an igniter head containing a primer is fastened. On the other a No. 8 combination mercury fulminate tetryl detonator is crimped.

c. Time of burning.—The burning time of the fuze can be shortened by cutting off part of the safety fuze and crimping on a new detonator (prohibited in training operations).

d. Safety feature.—When assembled, the fuze is protected from premature functioning by a safety pin contained in the burster-tube assembly (par. 9*d*).

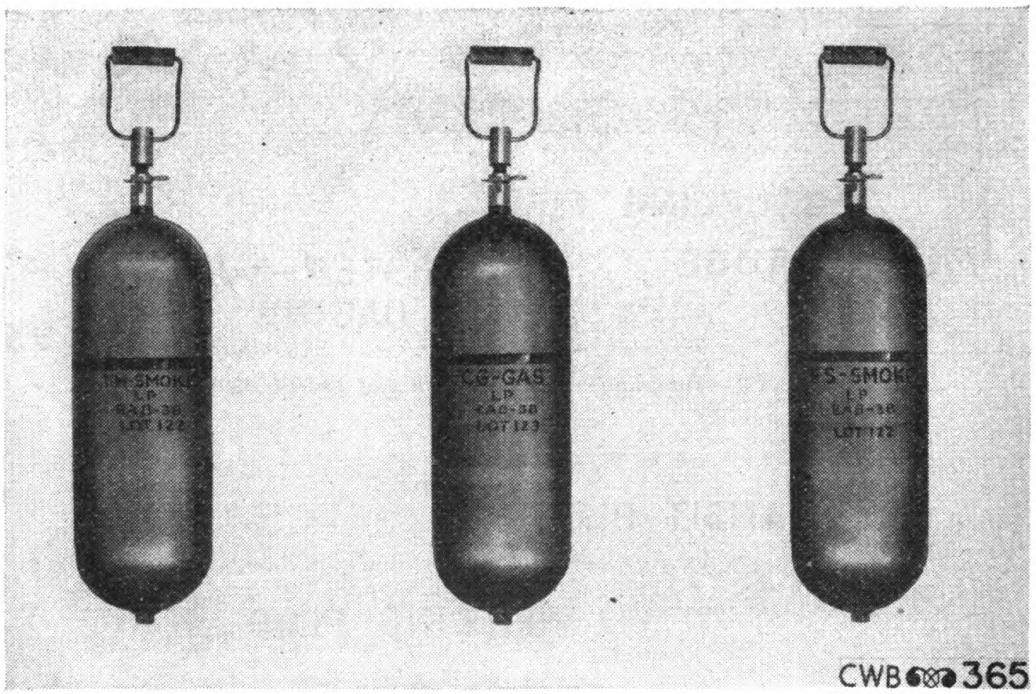

FIGURE 5.—Three types of filled shell.

e. Dimensions.—The approximate dimensions and weight of the fuze are:

Length, assembled	inches	13.75
Diameter of primer	inch	0.50
Diameter of fuze and detonator	do	0.25
Weight of assembled fuze	do	0.5

f. Marking.—On the primer end of the fuze the manufacturer's identification mark and the lot number are stamped.

g. Functioning.—The fuze is fired by means of an inertia pellet which is a component of the burster-tube assembly. When the shell

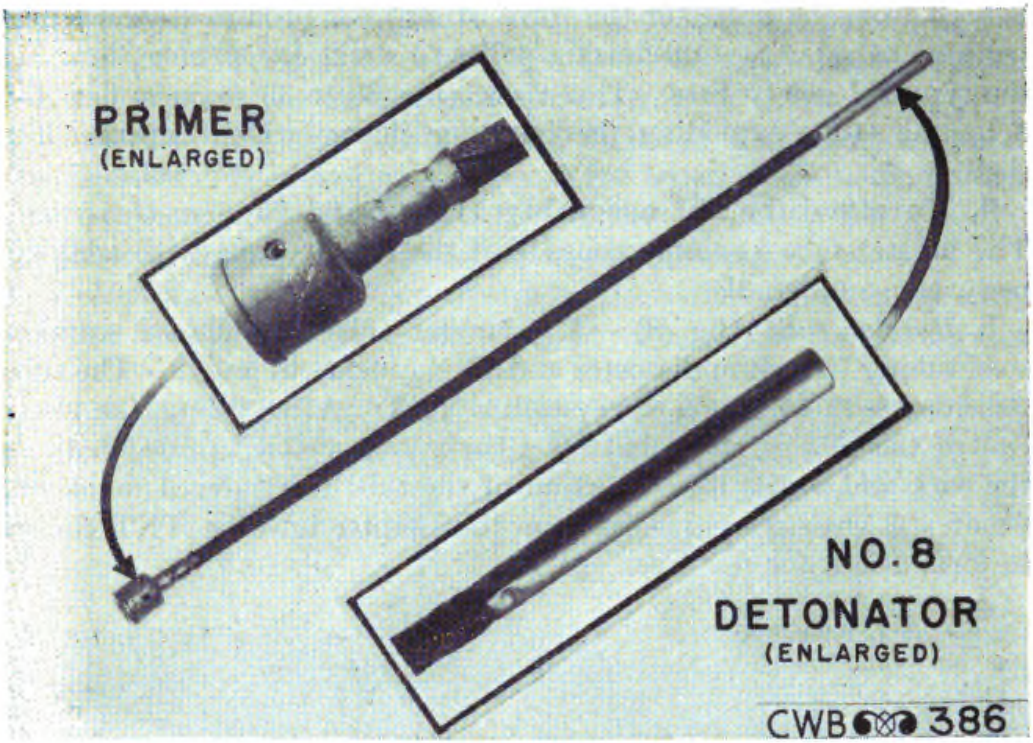

FIGURE 6.—Fuze MI assembly, showing primer and detonator.

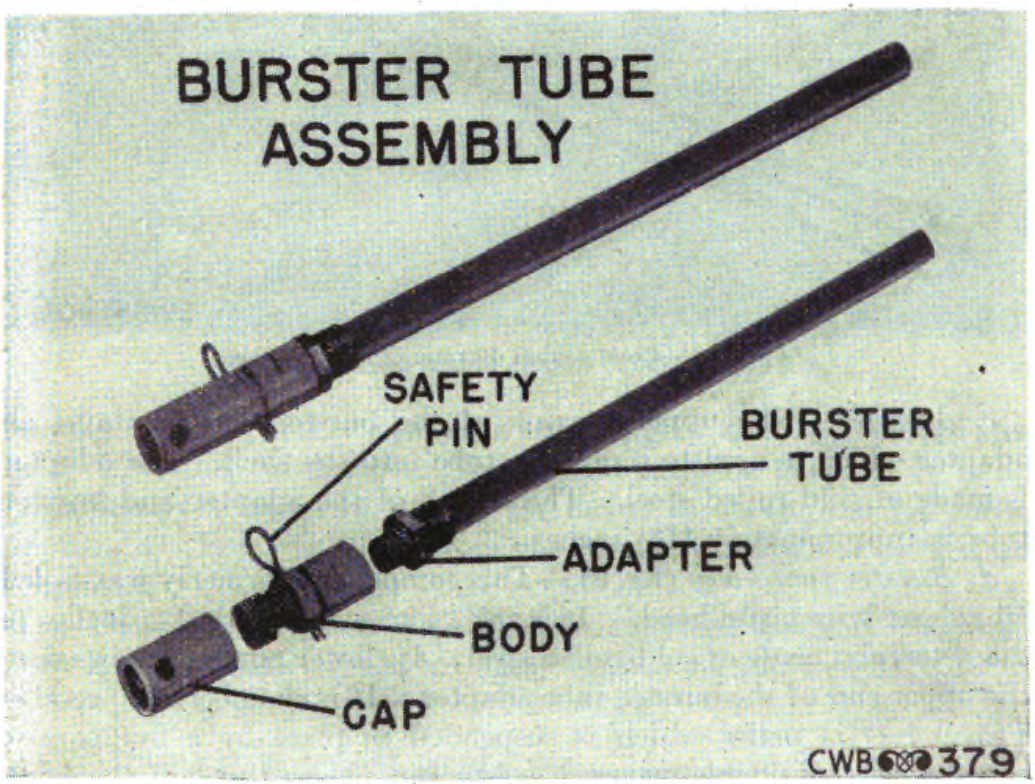

FIGURE 7.—Burster-tube MI assembly.

is fired from the projector the force of set-back produced by the propelling charge causes the inertia pellet to strike the primer, igniting the type III safety fuze. This then, after 30 to 36 seconds, fires the detonator, thus exploding the bursting charge which ruptures the shell.

9. Burster-tube MI assembly (figs. 7 and 25).—*a. General.*—The burster-tube assembly consists of the burster tube with adapter, body, cap, and handle.

b. Burster tube (fig. 8).—The burster tube is made of seamless steel tubing $\frac{7}{8}$ inch in diameter and $16\frac{15}{16}$ inches in length. The tube is loaded with 65 grams of crystalline TNT. After filling, the lower end of the tube is stoppered by a cork, and shellac applied both to the cork and to the lower portion of the tube to render it moisture-proof. A brass tube extends from the adapter into the TNT charge to form a well for the fuze.

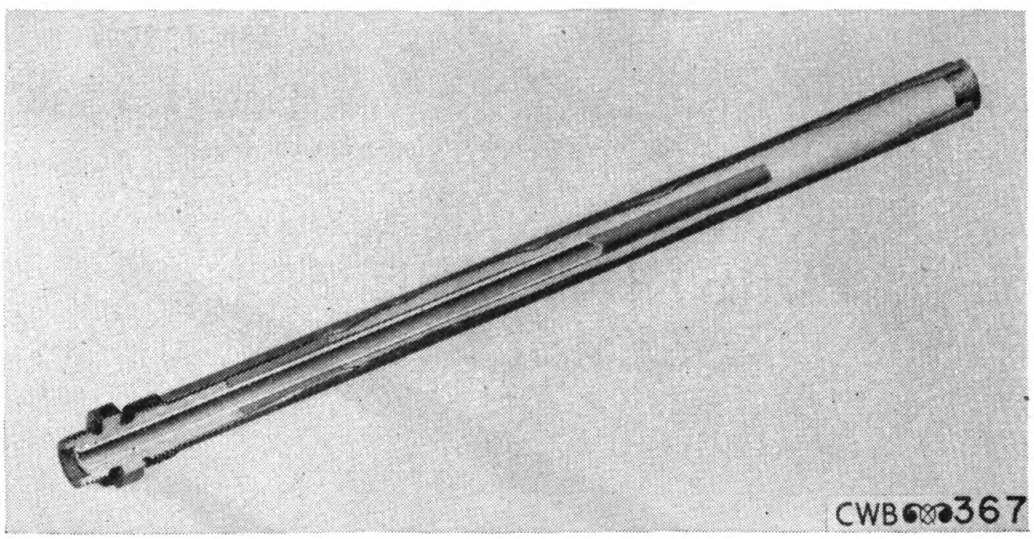

FIGURE 8.—Cross-section diagram of burster tube.

c. Adapter.—The upper portion of the burster tube contains an adapter which is used to screw the tube into the shell. The adapter is made of cold-rolled steel. The length of the adapter and burster tube is approximately $17\frac{3}{4}$ inches.

d. Burster-tube body (fig. 9).—This component formerly was called "the shear-wire pistol head." It is $2\frac{13}{16}$ inches in length, $1\frac{1}{4}$ inches in diameter, and made of cold-rolled steel. Its lower portion screws onto the upper end of the burster-tube adapter. It is chambered to receive a steel inertia pellet which is suspended in place by a fine copper shear wire. A double-pronged safety pin passes through the body

immediately under the inertia pellet and prevents any downward movement of the pellet. The pellet has a small pointed projection on its lower surface for firing the primer.

e. Burster-tube cap.—This cap is 2 inches in length and 1¼ inches in diameter. It screws on the top of the burster-tube body and provides protection for the shear wire. Two holes are in the upper end of the cap, opposite each other, for handle assembly.

f. Handle.—A handle is provided on the burster-tube cap for carrying the assembled round to the weapon. The handle weighs approxi-

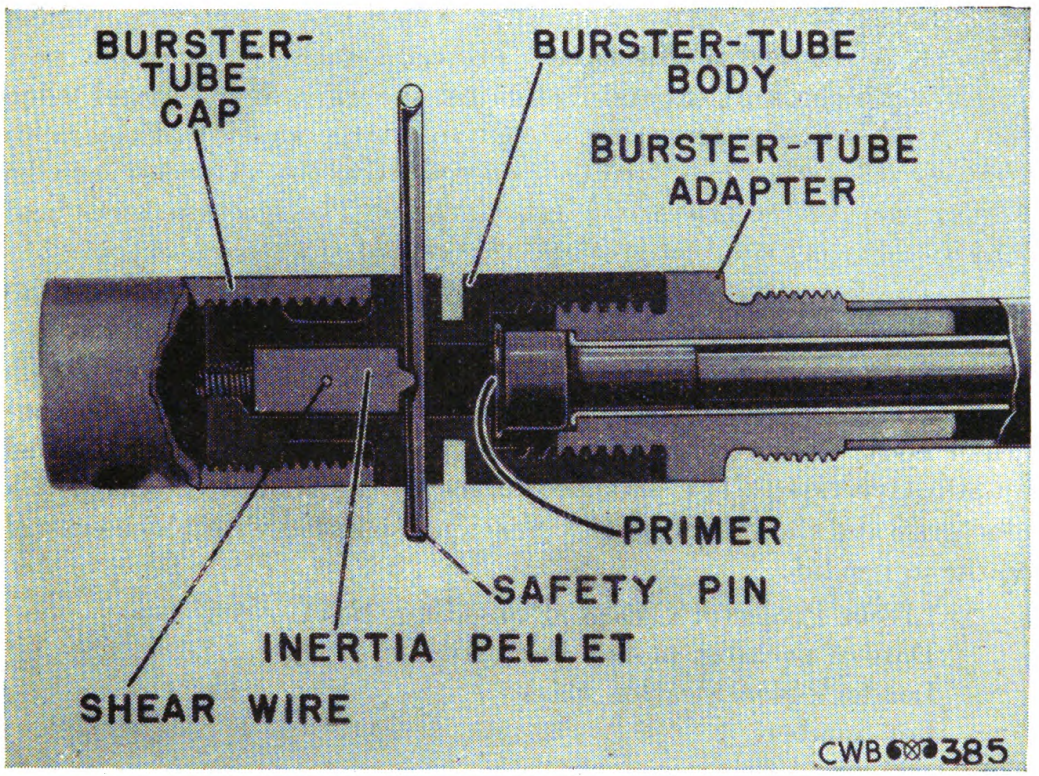

FIGURE 9.—Cross section diagram of burster-tube body.

mately 5 ounces, and consists of a wooden grip and a galvanized steel wide 0.244 inch in diameter, shaped like a spade handle. It is approximately 5 inches in length, 4¼ inches in width, and $1\frac{1}{16}$ inches in height. It is detached from the burster tube when packed for shipment.

g. Dimensions of assembly.—The burster-tube assembly (less handle) has the following approximate dimensions and weight:

Length	inches	22⅛
Diameter at largest point	do	1¼
Weight	pounds	2

10. Propelling charge MIII assembly (fig. 10).—*a. General.*—The approved propelling charge for the Livens projector is the charge MIII assembly. This consists of a charge container, a base charge, and a number of auxiliary smokeless powder charges. The range of the projector is controlled by the number of auxiliary powder charges used.

b. Charge container (fig. 11).—(1) The charge container is a cylindrical tin-plate box with top and bottom lids. Its outside diameter is 8⅛ inches and its height 5¾ inches. Inside the box are the powder charge, ignition squib and wires, and the gas check. The gas check is in the upper part of the container, which has a center depression to fit the lower end of the Livens projector shell. This upper part acts as a gas check by expanding against the walls of the barrel when the charge is fired, permitting a relatively large amount of clearance between projectile and barrel. Consequently, the projector can be loaded from the muzzle easily and quickly. The ignition wires lead into the charge container through the rim of the gas check.

(2) The lower lid of the container has two one-finger wire handles soldered to the outside. The upper lid has a hand grip wire handle. Upper and lower lids are held in place by two metal straps which hook through connector straps soldered to opposite sides of the container body. The cover joints of the upper and lower lids are sealed by adhesive tape. The outside surface of the container is coated a blue-gray and the following information is painted with black enamel on the upper lid:

Livens Projector Charge, Propelling, MIII.
Date of packing, month and year.
Loader's identification mark.
Lot number.

c. Propelling charges (fig. 12).—(1) *Base charge.*—The base charge consists of a red bag with 8 ounces of smokeless powder. The bag also contains an igniter bag of 10 ounces of glazed, grade A, No. 4 army black powder, with an electric squib, the wires of which are stitched to the igniter bag.

(2) *Supplementary charges.*—In addition to the base charge, the assembly contains two $\frac{1}{10}$-charge bags, each containing 4 ounces of smokeless powder, and three $\frac{1}{5}$-charge bags, each with 8 ounces of smokeless powder.

(3) *Range table.*—The shell may be fired by the base charge alone, or by the base charge and from 4 to 32 ounces of powder in addition. The weight in ounces of the charge used will always be a multiple

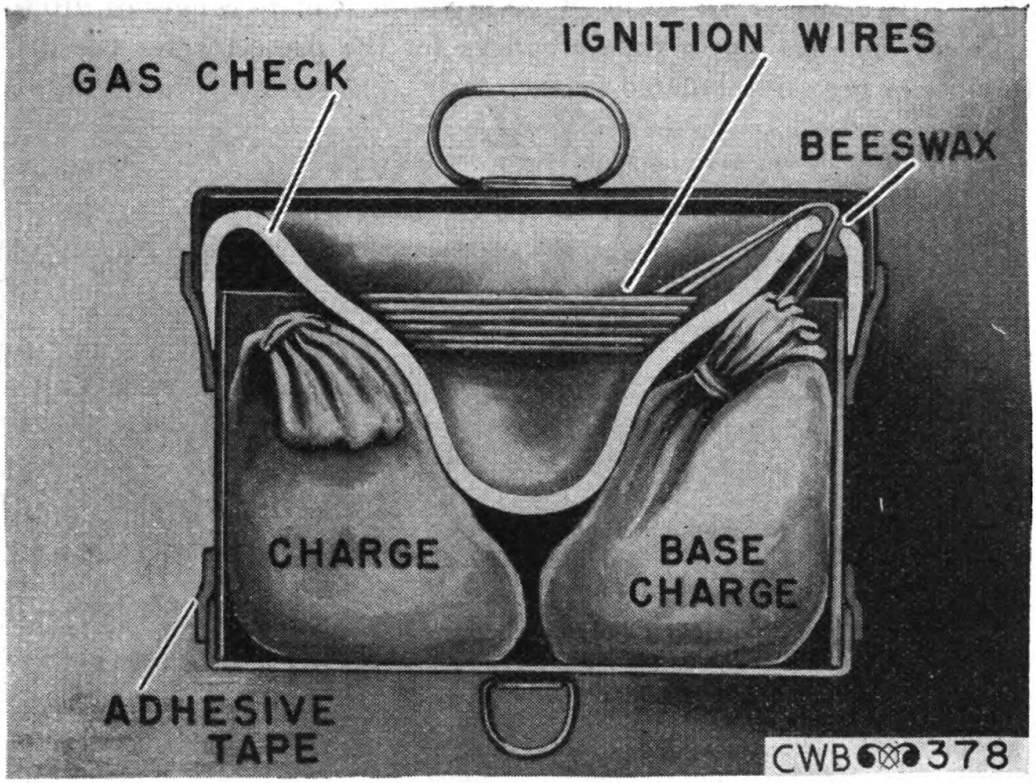

FIGURE 10.—Powder charges.

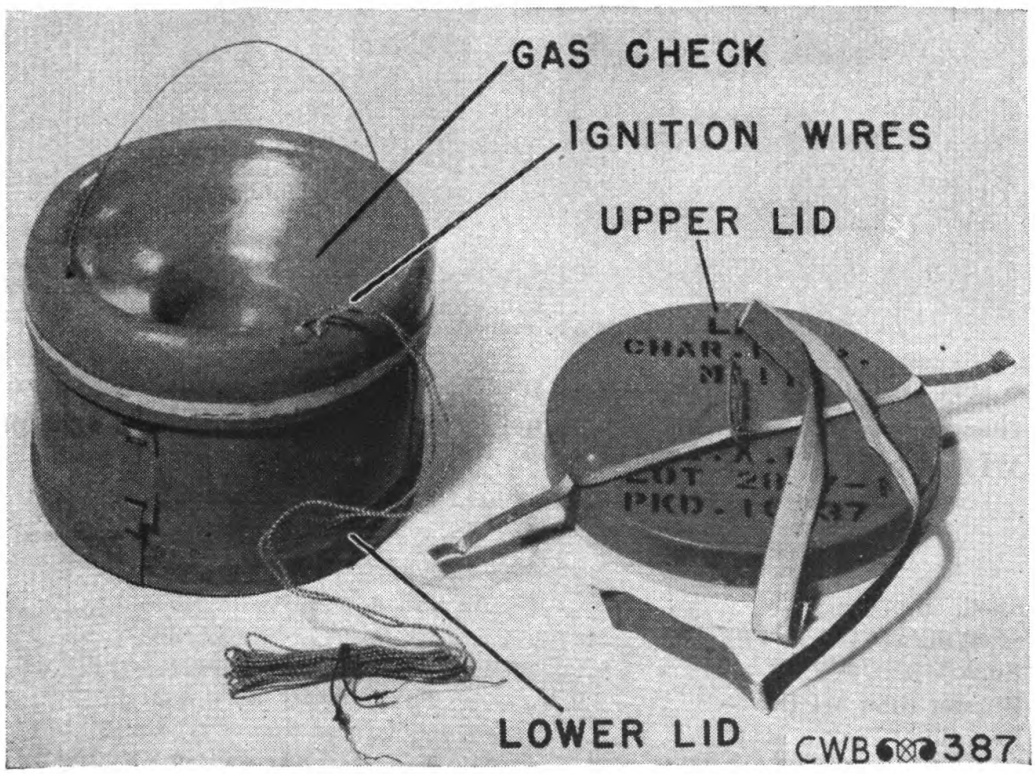

FIGURE 11.—Charge container with top lid removed.

of 4. Five zones of fire are used, giving approximate ranges of 910 to 1,450 yards. The approximate ranges for the projector for the different charges are tabulated below:

Propelling charge, smokeless powder (ounces)	Range (yards)
24	910–1, 010
28	1, 020–1, 120
32	1, 130–1, 230
36	1, 240–1, 340
40	1, 350–1, 450

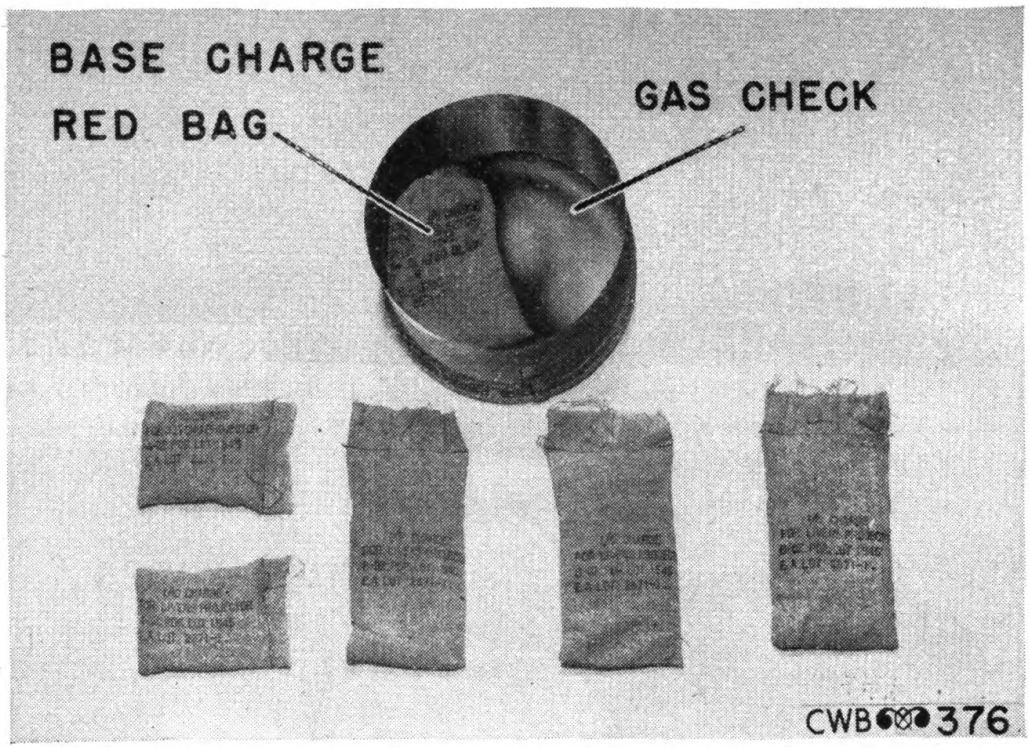

FIGURE 12.—Components of propelling charge MIII assembly.

11. Weight of component parts.—The approximate weights of the component parts of a complete round of standard ammunition MII and MIIA1 are:

	Pounds	Ounces
Shell, empty	33	
Shell filling (CG or FS)	28	
Fuze MI		0. 5
Burster tube MI (loaded)	2	
Propelling charge MIII	8	11
Weight of complete round	72	

SECTION IV

ACCESSORIES SET MI

12. General.—The Livens projector requires the use of the following accessories:

a. An accessories chest containing equipment needed for laying out the emplacement and instruments for testing the firing circuit.

b. Tools required for emplacing the projector.

c. Two blasting machines.

d. A reel for holding the firing wire.

13. Accessories set.—*a. Livens chest* (fig. 13).—The following components are packed in the projector chest together with a data card:

Quantity	Component	Unit weight		Unit dimensions
		Pounds	*Ounces*	*Inches*
1	Chest, Livens projector, accessories set, packed, complete.	24	4	
1	Chest, Livens projector, accessories set, empty.	10	12	25½ by 7⅜ by 8
1	Card, contents	Negative.		
1	Indicator, range, E1	Negative.		
1	Clinometer MI, Livens projector	0	5	7¾ by 6 by ½
1	Detector, circuit, Livens projector (galvanometer).	1	8	4⅜ by 3⅛ by 1¾
6	Stak, aiming	0	7	24 by ⅞ by ⅞
1	Tape, friction, ¾-inch, ½-pound roll	0	8	4 diameter by $^{13}/_{16}$
1	Tape, steel, 100 feet, graduated in meters and centimeters on one side and in feet, tenths of a foot, and hundredths of a foot on opposite side, c. t.	1	9	6 diameter by 1½
5	Tape, tracing, white twilled cotton, 1 inch wide, 100-foot roll.	0	4	5 diameter by 1
1	Roll, tool, complete with contents	4	0	
1	Roll, tool, empty			20 by 9¼ by ⅜
1	Knife, electrician, type TL–29	0	3	3¾ by ⅞ by 1⅛

Quantity	Component	Unit weight		Unit dimensions
		Pounds	*Ounces*	*Inches*
1	Pliers, combination, 8 inches, c. t.	0	13	8⅛ by 2 by 9/16
1	Rheostat, c. t.	0	4	4 3/16 by ¾ by 1⅞
2	Wrench	1	2	8⅛ by 2 3/16 by ⅝

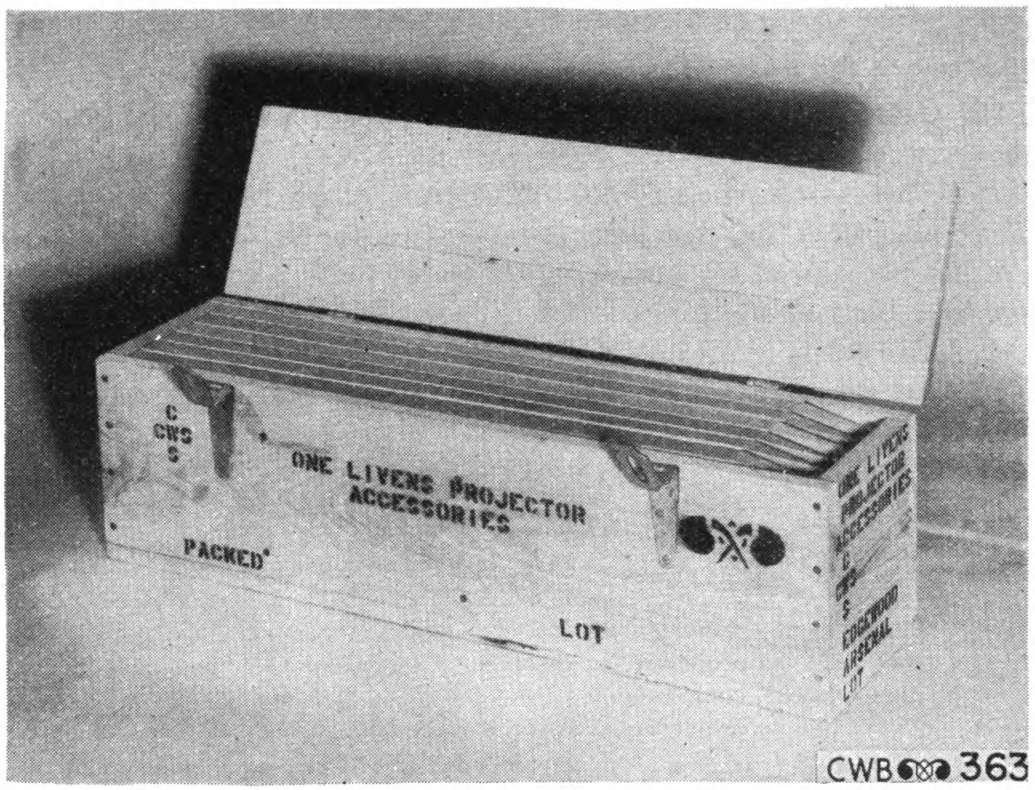

FIGURE 13.—Livens chest packed for shipment.

b. Other accessories.—Each accessories set includes the following items which are not contained in the chest. Their unit weight and unit dimensions are:

Quantity	Component	Unit weight		Unit dimensions
		Pounds	*Ounces*	*Inches*
1	Ax, single bit, handled	5	0	33½ by 7 by 1⅝
4	Pick, railroad, handled, c. t.	9	0	36 by 25 by 3
6	Spade, D-handled, c. t.	5	0	39 by 7¾ by 3¼
2	Machine, blasting, 100-cap, c. t	21	4	15¾ by 6½ by 8⅛
1	Reel, wire, firing	13	8	17½ by 11¾ by 11¾
1,000	Feet wire, copper, No. 14, B. & S. gage, covered, double lead, firing.	36	0	16 diameter by 3

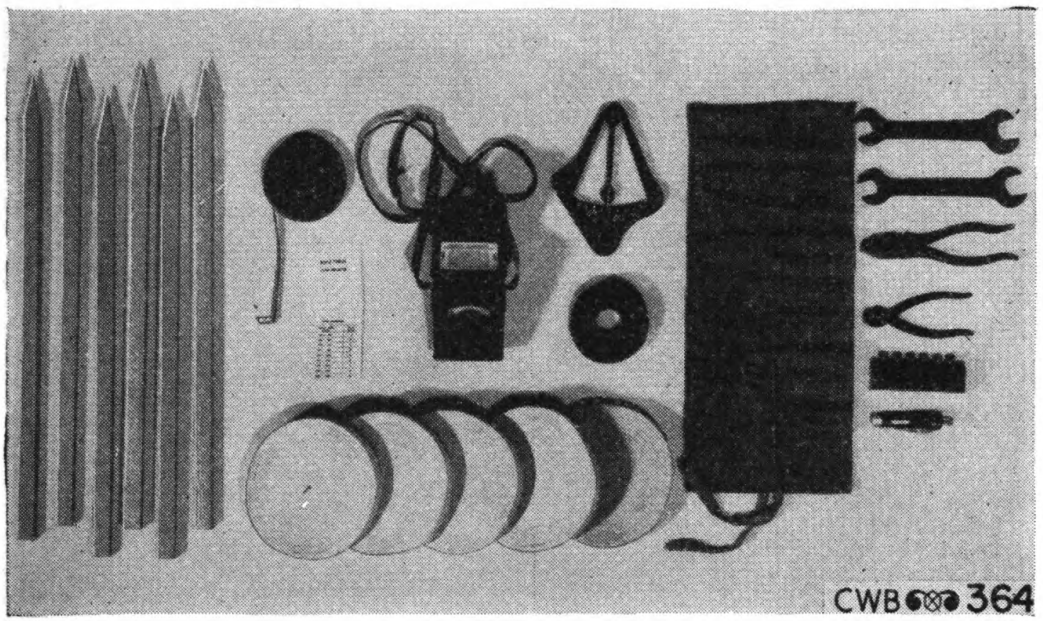

FIGURE 14.—Components of Livens chest.

14. Clinometer MI (fig. 15).—The clinometer used with the Livens projector is a triangular-shaped aluminum frame with a pointed pendulum suspended at the apex. Aluminum plates attached to each side of the base are graduated from 35° to 75° in divisions of 5°. The pendulum bob and projecting pointer, as well as the graduations and figures on the plates, are outlined with luminous paint.

15. Galvanometer (circuit detector) (fig. 16).—*a. Purpose.*—The galvanometer, or circuit detector, is an instrument used for testing electric blasting caps and squibs, and for determining whether the projector circuit is in proper condition for firing, whether there is a break in the circuit, whether there is a short circuit or leak, and the approximate resistance of the circuit.

b. Description.—The galvanometer is an electric instrument in which a current from a small chloride of silver cell moves a pointer across a scale. The cell and needle are contained in a small case made of metal and hard rubber and provided with two contact posts for connections. The instrument is in turn contained in a leather case cut out to show the scale and furnished with a carrying strap. The galvanometer is small and flat and of convenient size to carry in the pocket. The battery is of long life and of great constancy, but is so weak that the current sent through an electric blasting cap, when making a test with the assembled instrument, is less than one-tenth the strength required to explode it.

16. Blasting machine (fig. 17).—The blasting machine, sometimes termed an exploder, is used for firing the propelling charges in

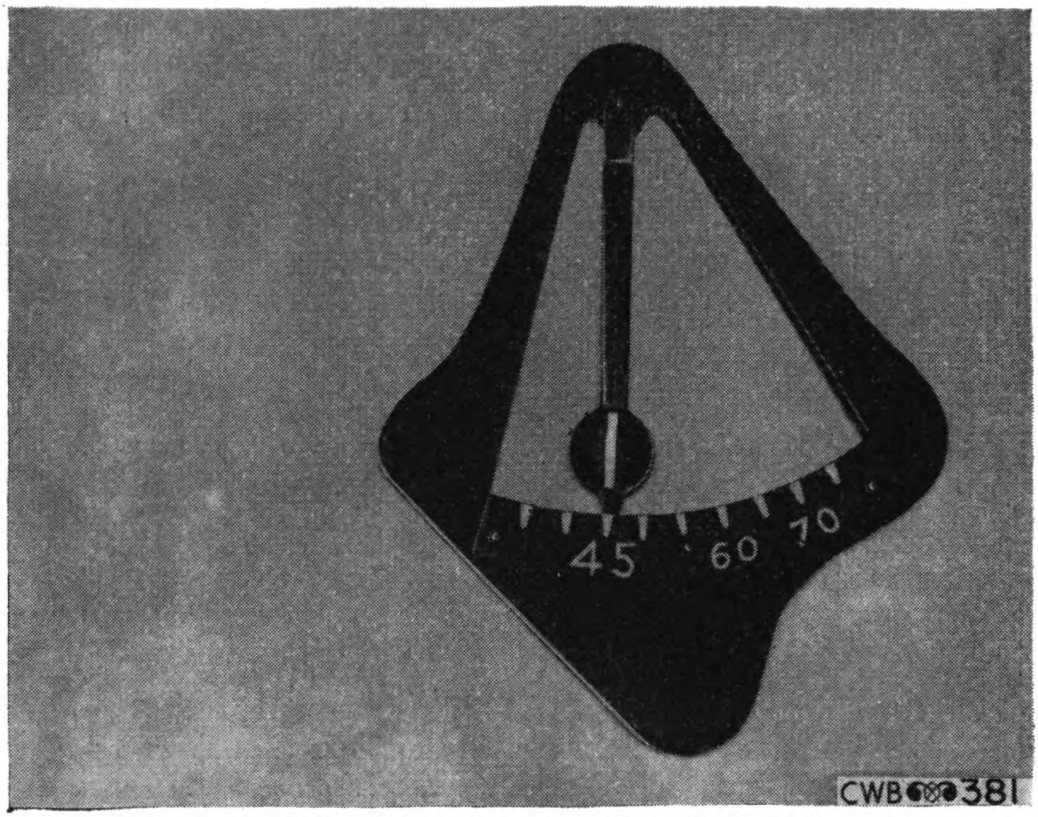

FIGURE 15.—Clinometer—graduations coated with aluminum paint.

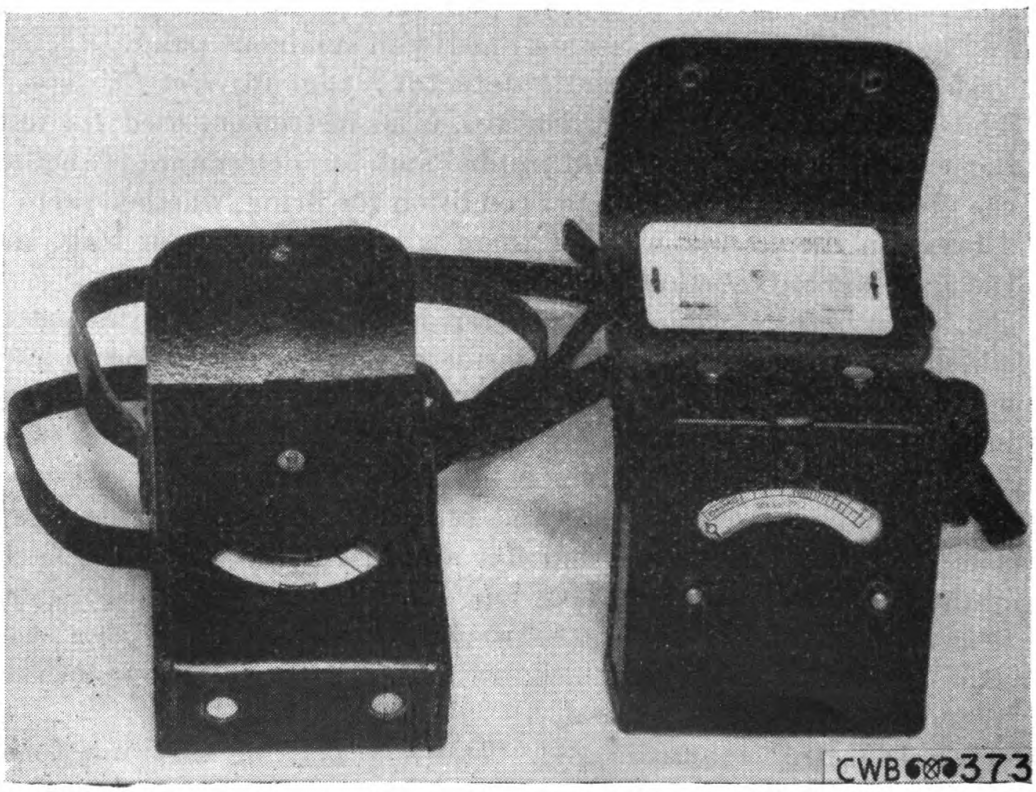

FIGURE 16.—Common types of galvanometers (circuit detectors) used with Livens projector.

a battery of Livens projectors. The machine is plunger-driven and has a rated capacity of 100 blasting caps or squibs, but is used to fire at one time not more than 25 projectors in a battery.

17. Rheostat (fig. 17).—*a. General.*—The rheostat is an instrument for testing the operating condition and capacity of the blasting machine. It consists of a series of graded resistance coils to which

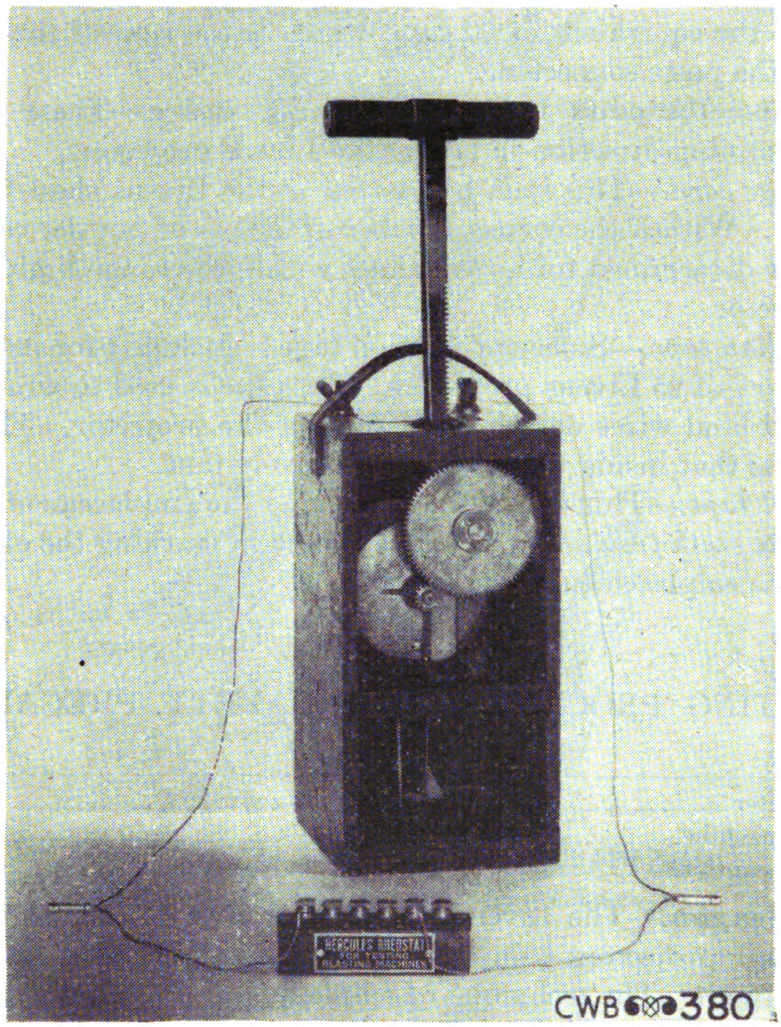

FIGURE 17. Blasting machine wired with rheostat and two squibs for testing its efficiency.

binding posts connect at various points and represent the equivalent resistance of a given number of electric squibs or detonators. Figures stamped on the side of the rheostat between the six binding posts indicate the number of squibs or detonators represented by the resistance between the posts, as 5, 10, 20, 25, and 40, making a total resistance representing 100 squibs or detonators between the end posts.

b. Use.—To test the blasting machine, connect two squibs, one between each of the end posts of the rheostat and each of the terminals of

the blasting machine. Thrust the plunger of the blasting machine down once vigorously. If the squibs fire, the machine is in good operating condition to its maximum capacity of 100 caps. If the squibs fail to fire, change the connections on the rheostat, reducing by the lowest number, until firing is obtained. The sum of the numbers between the posts then connected is the number of caps that the machine is able to fire. Figure 17 shows the blasting machine connected to the equivalent of 60 caps, which is the sum of the numbers between the posts connected.

18. Miscellaneous items.—*a. Aiming stakes.*—These are used for determining direction in laying the Livens projector.

b. Range card.—This item is inserted in the Livens chest for ready reference. With it the correct number of ounces of powder can be immediately determined for any distance within the range limitations of the projector.

c. Friction tape.—Sufficient friction tape is included for installation of a battery of 25 Livens projectors. The tape is used to wrap spliced wires and bind wires outside the barrel of the projector. This latter use insures that inside wires will be relatively taut.

d. Steel tape.—This is used in measuring the emplacement.

e. White cloth tracing tape.—This is used in marking the exact position of the emplacement to be dug.

Section V

OPERATING PROCEDURE AND SAFETY PRECAUTIONS

19. Weapon.—The Livens projector is always fired as part of a battery, all projectors being discharged simultaneously through an electric circuit. The technique of emplacing and firing the battery is given in FM 3–20, but the operating procedure for one projector follows:

a. Emplacement (fig. 18).—(1) To emplace the base plate, an excavation is made 8 inches wide, 8 inches deep, and about 13 inches long, with the long dimension at right angles to the target. The front and rear walls are next sloped at an angle of 45°. The excavation is completed by undercutting the front wall to receive the front edge of the base plate. To make the under cut, a cut is made perpendicularly from a line on the front wall 2 inches up from the bottom of the trench. The rear slope is continued down until it meets the perpendicular cut

made in the front slope. This is the semisurface set-up and is used when the soil is firm. When it is loose, the projector must be emplaced more deeply.

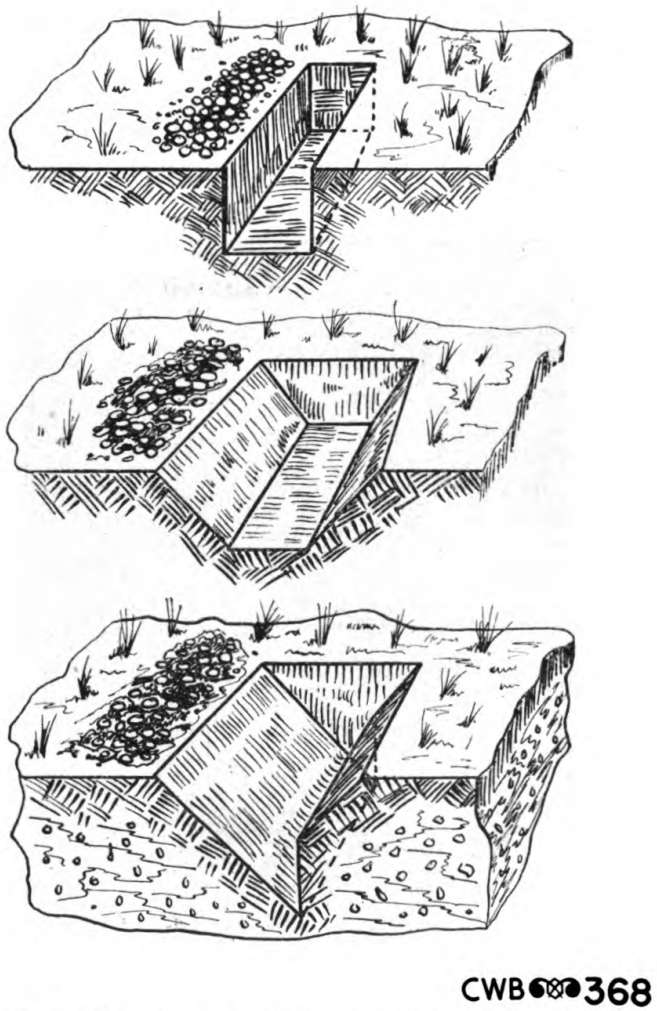

FIGURE 18.—Steps in digging trench for emplacement.

(2) After the barrel has been set in the emplacement, and before filling the latter with the removed dirt, the base of the clinometer is placed on top of the barrel. The muzzle of the projector is raised or lowered until the index mark on the end of the pendulum coincides with 45° (800 mils) on the scale (fig. 19).

(3) All loose earth is thrown back around the emplaced weapon and tamped down, care being taken not to disturb the laying of the projector. Angle and sight are frequently rechecked during this procedure.

b. Preparing round.—(1) The charge box (fig. 12) is opened and the necessary change made in the amount of powder to be used if the range is less than the maximum. The charge box is tested as explained

in paragraph 20. The upper lid of the container is left off but the lower lid is replaced after the powder is adjusted.

(2) The burster-tube assembly is next taken from its container and the burster-tube body unscrewed from the burster tube (fig. 7).

(3) The transit plug is unscrewed from the shell and the burster tube is screwed into the shell (fig. 20).

(4) The fuze is inserted in the burster tube and the burster-tube body screwed back on (fig. 21). The round is now ready for loading.

FIGURE 19.—Checking elevation of barrel.

c. Loading and firing.—(1) The charge box is placed in the projector with the ignition wires up. The wires are bent over the muzzle and kept along the top inside of the barrel by making them taut and attaching them to a wooden stake at the rear of the baseplate.

(2) The shell is lowered into the barrel and the handle removed.

(3) If the projector is not to be fired immediately, the muzzle cover should be put on to prevent moisture and dirt from collecting inside the barrel.

(4) The ignition wires are connected in series to the firing wires and then to the blasting machine.

(5) Before firing, the safety pin is removed.

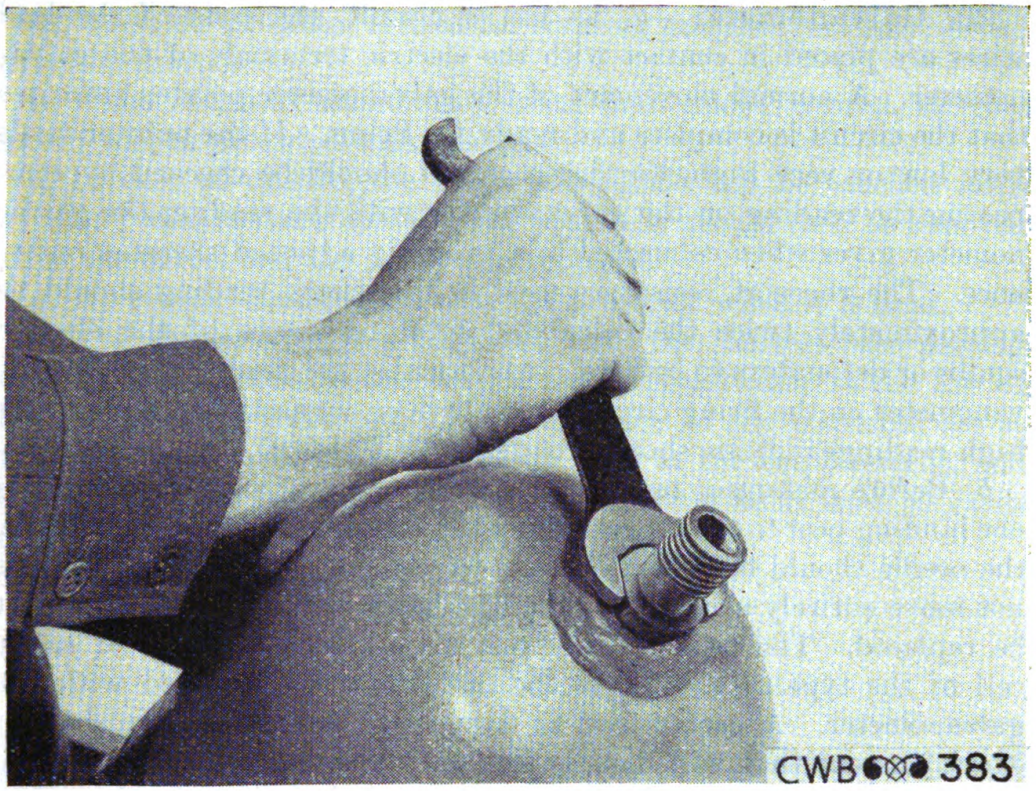

FIGURE 20.—Burster-tube assembly screwed into shell and tightened with wrench.

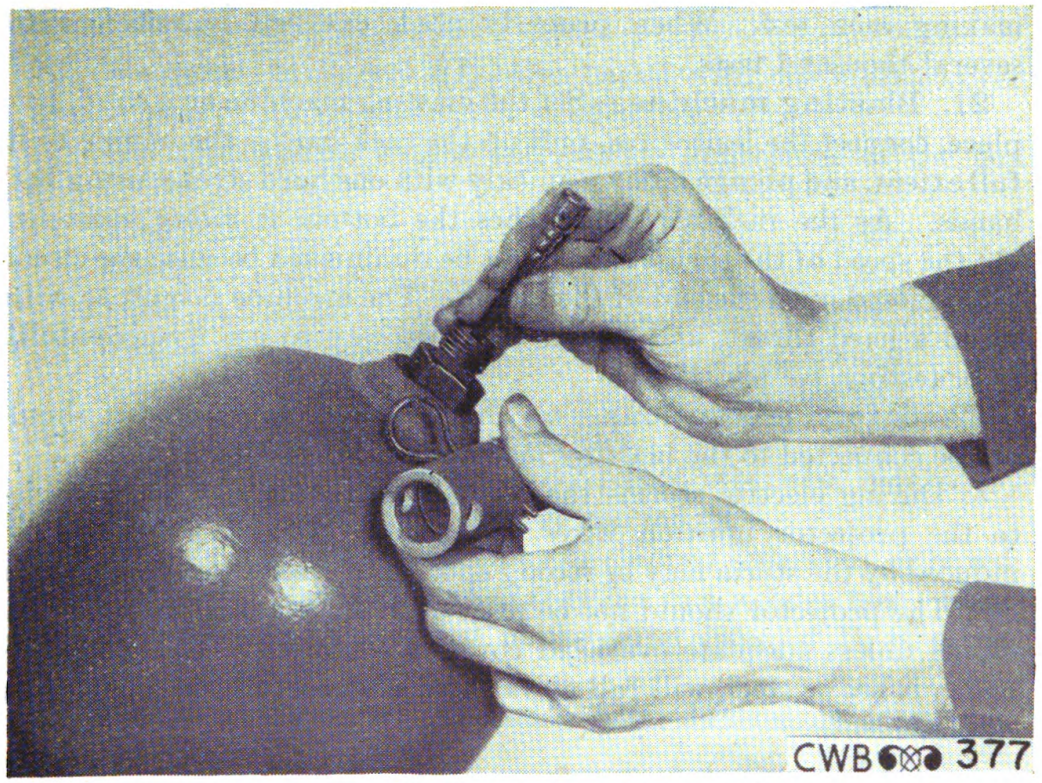

FIGURE 21.—Inserting fuze in burster tube.

20. Galvanometer.—*a.* To test a circuit, the ends of the lead wires are placed in contact with the electric terminals of the galvanometer. A normal movement of the galvanometer pointer indicates that the circuit is complete and ready for firing. If the pointer reads very low or very high, the firing circuit should be checked by comparing the reading on the galvanometer with the reading the galvanometer gives when connected to a properly adjusted rheostat resistance. The rheostat resistance used in this check reading should be approximately twice the calculated total resistance of the electric squibs or detonators to be fired. Abnormally low readings of the galvanometer on the firing circuit indicate poor connections; abnormally high readings indicate short circuits. (See FM 5–25.)

b. Before making a test, place a short piece of copper wire from one binding post to the other. Since the wire has almost no resistance, the needle should be deflected to its widest limit. If the needle does not move entirely across the scale, the battery cell is weak and must be replaced. The replacement must always be a chloride of silver cell of the type or similar to the one originally supplied with the galvanometer. A carbon cell is dangerous because it furnishes an excess current that will damage the galvanometer and may fire the squibs. The length of time a cell will last depends upon how frequently it is used and how long the current is allowed to flow in making each test. When properly used, one cell is sufficient for several thousand tests.

21. Blasting machine.—Set the blasting machine on a solid, level place, connect the lead wires, pull up the rack-bar by the handle to its full extent, and plunge it down quickly with one hard stroke, using both hands. As the rack-bar approaches the bottom it meets resistance, but the speed of the thrust should not be diminished because the circuit is not closed until the end of the stroke. The machine is built to withstand a hard thrust, and that is the only way to use it successfully. (For testing, see par. 17*b*.)

22. Safety precautions.—*a.* The projector firing circuit should not be connected to the blasting machine until time for firing.

b. During electric storms the firing wire should not be connected to the projector ignition wires. If a long wire is used, currents induced by the storm may be strong enough to discharge the projector.

c. The projector should not be fired over the heads of friendly personnel unless adequate overhead cover is employed. The gas check, which is heavy steel, will fall at variable distances to the front of the emplacement.

d. When the projector is fired for training purposes, the fuze should *never* be shortened.

e. When chemical ammunition other than smoke is fired, all personnel will be provided with gas masks.

f. In case of misfire, the projectors should not be touched until *at least 1 minute has elapsed.* The projectile should then be removed from the barrel and the safety pin replaced.

g. No person should stand near the projector when it is fired.

h. The danger area is a trapezoid with the shortest base passing through the position of the weapon and perpendicular to the line of fire bisecting the trapezoid. The dimensions of the trapezoid are as follows: 1,800 yards long, 300 yards wide at the emplacement, and 600 yards at the farther end. Personnel should be at least 50 yards to the rear of the emplacement while firing.

SECTION VI

PACKING, SHIPPING, AND STORAGE

23. Weapon.—*a. Barrel MI.*—One barrel with one muzzle cover is usually packed for shipment in a wooden box.

(1) The approximate weight and outside dimensions of the box are:

Length	inches	41¼
Width	do	11¼
Depth	do	11½
Weight of box, packed	pounds	145
Displacement of box	cubic feet	3.09

(2) I. C. C. regulations—Not applicable.

(3) Shipping name—Gun, N.O.I.B.N. (not otherwise indexed by name), bore 6 inches and over, without gun mount.

b. Base plate MI.—Base plates may be shipped separately or boxed. If boxed, five base plates are packed together in a wooden box. Shipments are marked as prescribed in the latest issue of U. S. Army Specification 100–2.

(1) The approximate weight and outside dimensions of the box are:

Length	inches	26¾
Width	do	21½
Depth	do	14¾
Weight of box containing five base plates	pounds	185
Displacement of box	cubic feet	4.9

(2) I. C. C. regulations—Not applicable.

(3) Shipping name—Gun mount parts, N.O.I.B.N.

c. Muzzle cover MI.—The muzzle cover, usually shipped in place on the barrel, may be shipped separately. When shipped boxed, it is customary to pack 100 covers in a wooden box.

(1) The approximate weight and outside dimensions of the box are:

Length	inches	23
Width	do	17½
Depth	do	22¾
Weight of box, packed	pounds	76
Displacement of box	cubic feet	5.3

(2) I. C. C. regulations—Not applicable.

(3) Shipping name—Gun mount parts, N.O.I.B.N.

24. Ammunition, general.—The ammunition for the Livens projector is packed in wooden boxes for shipment, together with a data card in each box. The address side of all shipping boxes will have the following stenciled upon them in black:

a. Name of consignor in the upper right-hand corner.

b. Name and address of the consignee in the center.

c. Displacement of the box in cubic feet and the gross weight in pounds in the lower left-hand corner, one above the other.

d. "U. S." in the upper right-hand corner to indicate property of the United States.

e. In the lower right-hand corner, one above the other, the lot number and number of shipping ticket.

25. Shell.—*a. Packing.*—Filled shells are packed one to a box (fig. 22) and, after the lid is nailed on, metal straps are used to bind the ends. Following are the shipping data on each box:

(1) *Approximate dimensions and weight of shipping box.*

Length	inches	26⅝
Width	do	9⅞16
Height	do	9⅞16
Weight, empty	pounds	20
Weight, packed	do	83
Displacement of box	cubic feet	1.4

(2) *Marking.—(a) Gas shell.*

1. The markings on the packing box for shell loaded with nonpersistent gas, phosgene (CG), give the following information:

Quantity and kind of shell.
Lot number.
Month and year of packing.
CWS insignia.
Shipping name as prescribed by Interstate Commerce Commission regulations and shipping container specification number.

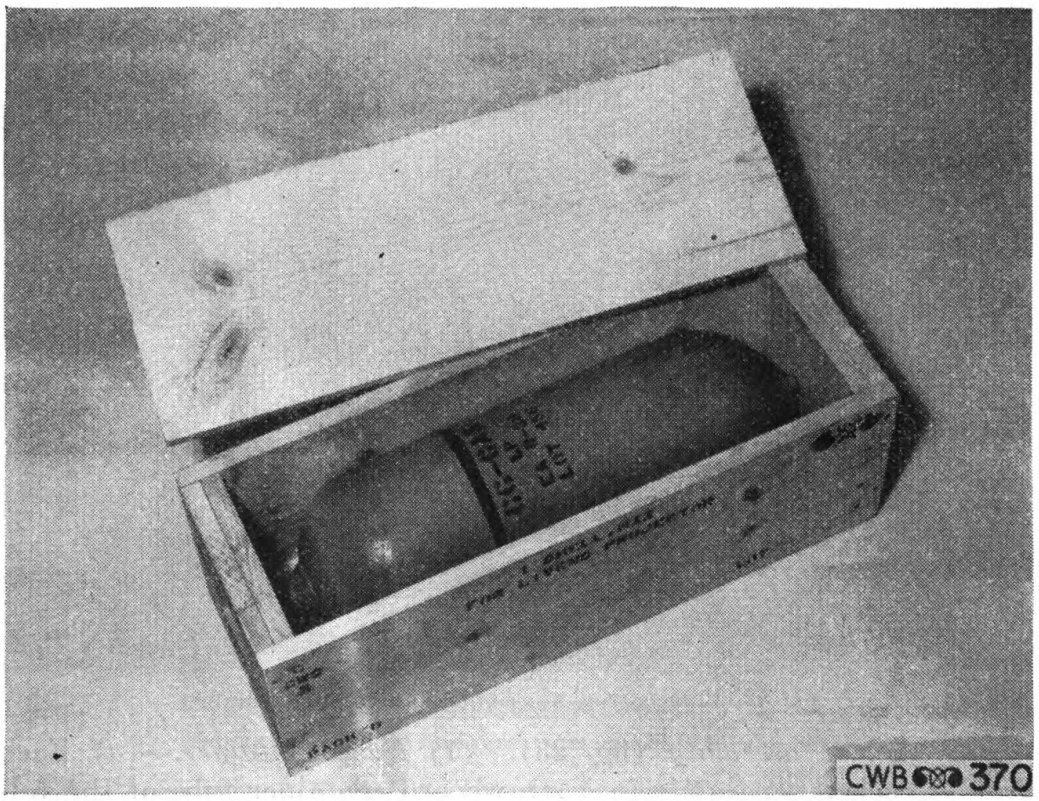

FIGURE 22.—Each filled shell packed in individual wooden box.

2. On both ends of the box the following information is given:

Quantity and kind of shell.
Name of place where packed.
Lot number.
CWS insignia.
One ½-inch green band painted on lower portion of left batten, between two blue-gray bands, each ¾-inch wide.

3. I. C. C. regulations—For shells filled with phosgene (CG), paragraphs 73, 515, 516, and 519 of the Interstate Commerce Commission regulations apply.

4. Shipping name—Phosgene in Steel Shell.

(*b*) *Smoke shell.*

1. The packing boxes containing shell filled with the smoke material, FS, are marked in the same manner as shell containing CG with the exception that the band on the left batten of the box is yellow instead of green.

2. I. C. C. regulations—Paragraphs 73, 357, 376, and 380 of the Interstate Commerce Commission regulations apply.

3. Shipping name—Acids N. O. I. B. N., liquid, in steel cylinder.

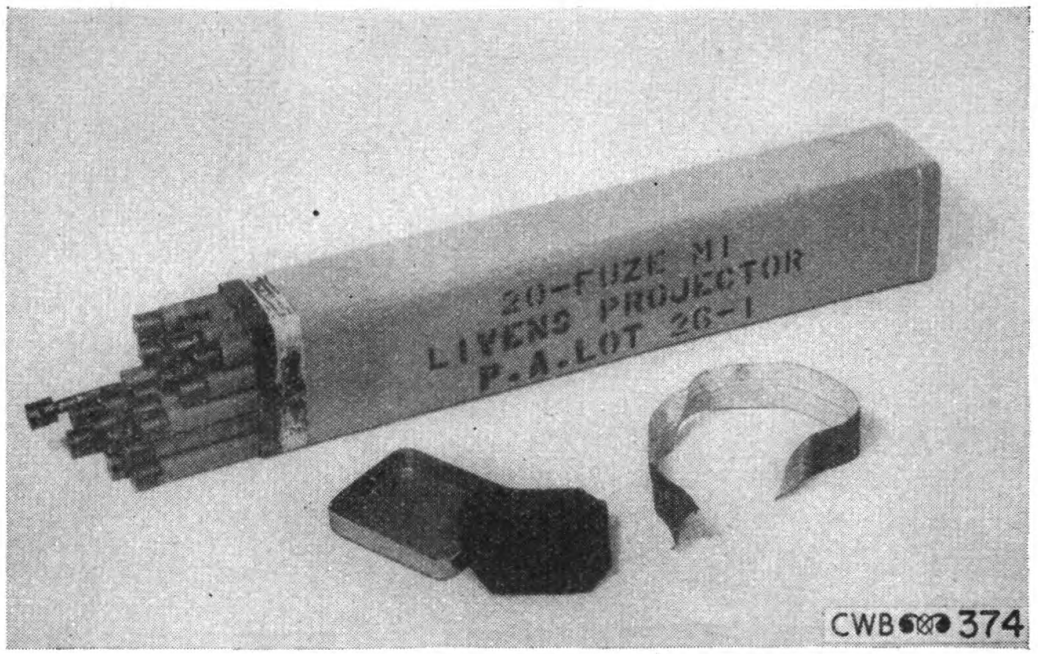

FIGURE 23.—Twenty fuze assemblies packed in tin container.

b. Fuze MI assembly (fig. 23).—(1) *Fuze container.*—(*a*) Each fuze is packed separately in a strawboard container tube of the following dimensions:

Length	inches	13¾
Inside diameter	inch	⅜
Outside diameter	do	17/32

(*b*) Twenty of these packed fuzes are placed in a tin container, having the following approximate outside dimensions:

Length	inches	15
Width	do	2¼
Depth	do	2¾

(*c*) A soft felt pad is placed inside each end of the container to protect the fuzes against shock. The joints between the lid and the container are made moistureproof with adhesive tape and one coat of shellac.

(*d*) The outside of the container is painted olive-drab, with the following stenciled in black:

20 FUZE MI
LIVENS PROJECTOR
(Manufacturer's identification mark)
(Lot number)

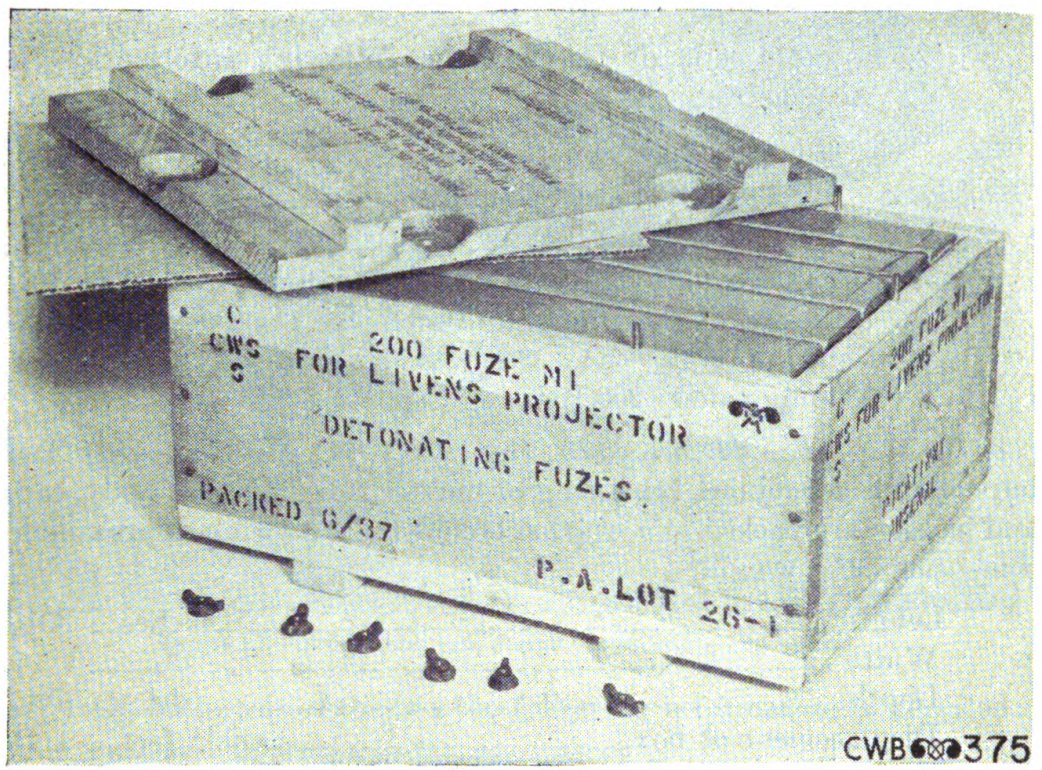

FIGURE 24.—Ten tin fuze containers packed in wooden box.

(2) *Packing box* (fig. 24).—(*a*) *Packing.*—Ten tin fuze containers (200 fuzes) are packed in a wooden box of the following approximate outside dimensions and weight:

Length	inches	17 1/16
Width	do	13 3/4
Depth	do	5 7/8
Weight	pounds	64.0
Displacement of box	cubic feet	0.76

The box is lined with corrugated strawboard and an ammunition data card placed within. The lid is secured by screws and the ends bound with metal straps.

(*b*) *Marking.*—In addition to the standard markings prescribed in the latest issue of U. S. Army Specification 100–2, the following markings must be shown on the packing box:

1. On one side the following information is stenciled with black paint:

Quantity and kind of fuzes.
Lot number.
Month and year of packing.
CWS insignia.
Shipping name, together with the I. C. C. shipping container specification number.

2. On both ends of the box the following information is stenciled:

Quantity and kind of fuzes.
CWS insignia.
Name of place where packed.

3. I. C. C. regulations—Paragraphs 78, 79, 80, and 86 to 101, inclusive, of the Interstate Commerce Commission regulations apply.

4. Shipping name—200 Blasting Caps.

c. Burster-tube MI assembly (fig. 25).—(1) *Packing.*—(*a*) Ten burster-tube assemblies, consisting of burster tube, adapter, body, cap, and handle, are packed in a wooden box of the following approximate dimensions and weight:

Length	inches	30¼
Width	do	9
Depth	do	7 5/16
Displacement of box	cubic feet	1.15
Weight, packed	pounds	32

(*b*) The assemblies (less handles) are packed in two rows of five each. Ten handles are packed in a small compartment in one end of the box. An ammunition data card is included, the lid fastened by means of screw hooks and thumbscrews, and the box sealed on all sides.

(2) *Marking.*—Shipments are marked as prescribed in the latest issue of U. S. Army Specification 100–2, with the additional markings indicated below:

(*a*) The following information is stenciled on one side of the box.

Quantity and kind of burster tube.
Lot number.
Month and year of packing.
CWS insignia.
Shipping name, together with I. C. C. shipping container specification number.

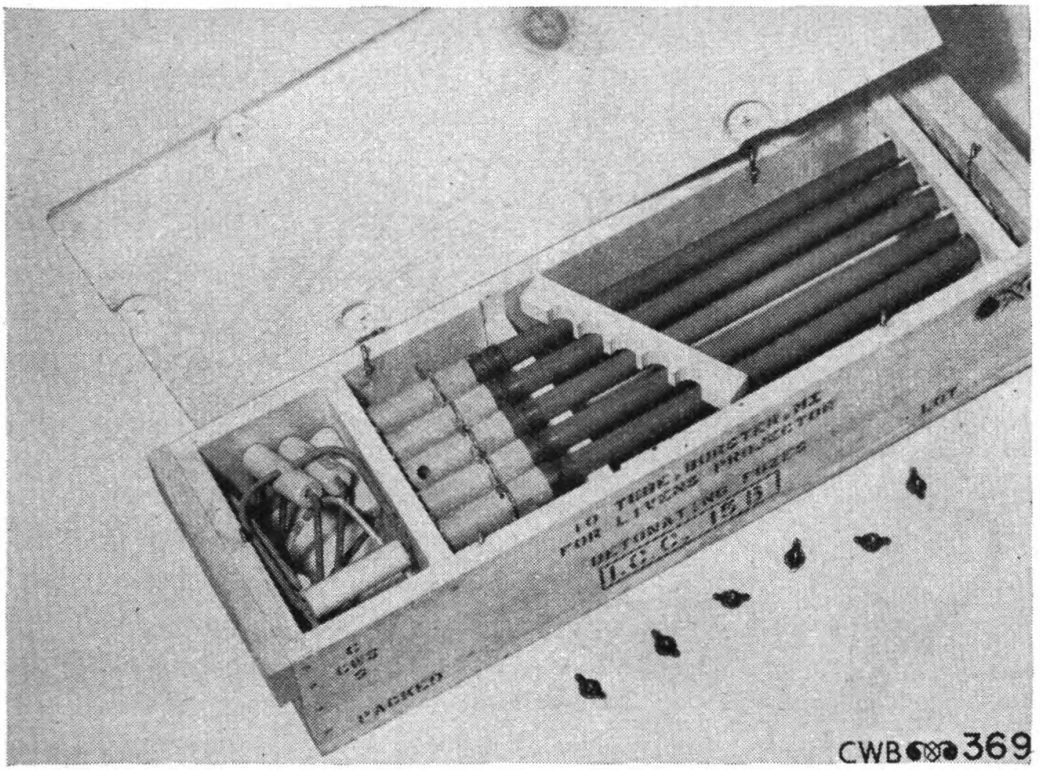

FIGURE 25.—Ten burster-tube assemblies packed in wooden box.

(*b*) On both ends of the box the following information is stenciled:

Quantity and kind of burster tube.
CWS insignia.
Name and place where packed.
Lot number.

(*c*) I. C. C. regulations—Paragraphs 82 to 101, inclusive, of the Interstate Commerce Commission regulations apply.

(*d*) Shipping name—Detonating Fuzes.

d. Propelling charge MIII assembly.—(1) *Packing* (fig. 26).—The propelling charge MIII assembly is packed four in a wooden box, together with an ammunition data card. The box is closed and bound at the ends with metal straps. The approximate dimensions and weight of the packing box are:

Length	inches	34⅝
Width	do	10⅝
Depth	do	10½
Weight, empty	pounds	20
Weight, packed, containing four charges	do	56
Displacement	cubic feet	2.23

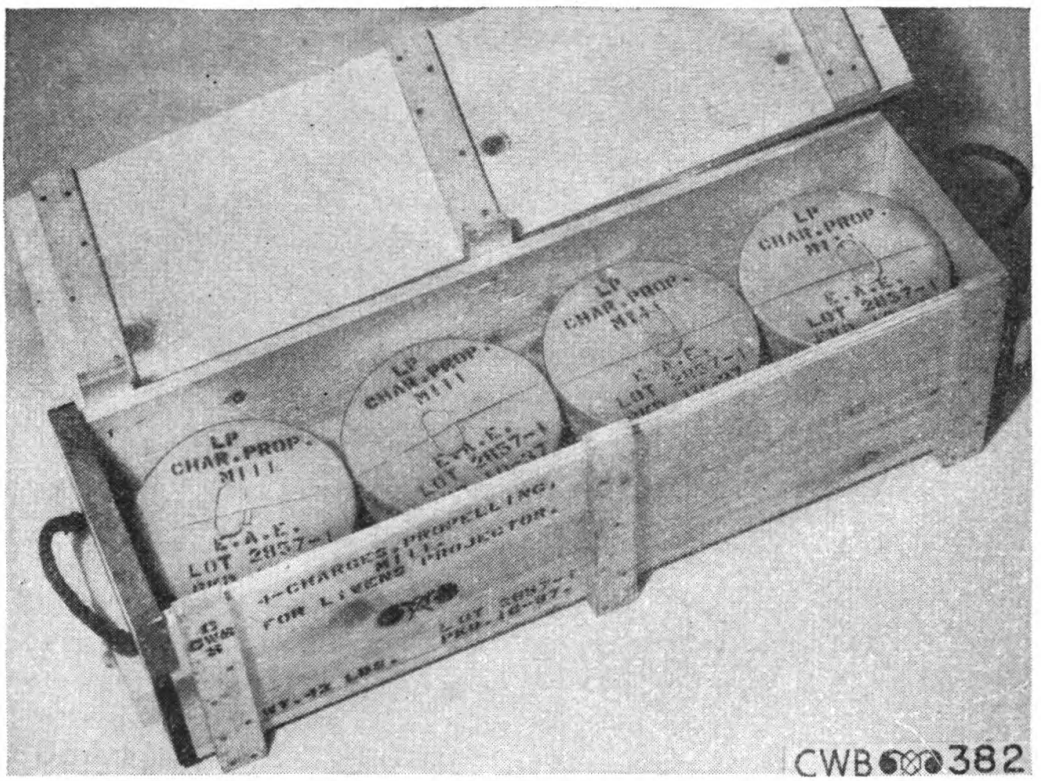

FIGURE 26.—Four propelling charge assemblies packed in wooden box.

(2) *Marking.*—The box is marked in accordance with U. S. Army Specification 100–2, and other data as indicated below.

(*a*) On one side the following is stenciled with black paint:

Quantity and kind of propelling charge.
Month and year of packing.
CWS insignia.
Shipping name and shipping container specification number as prescribed by I. C. C. regulations.

(*b*) On both ends of the box the following data are stenciled:

Quantity and kind of propelling charge.
CWS insignia.
Name of place where packed.
Lot number.

(*c*) I. C. C. regulations—Paragraphs 102 to 105, inclusive, of Interstate Commerce Commission regulations apply.

(*d*) Shipping name—Smokeless Powder for Cannon ——— (specify type of container).

26. Accessories set.—*a. Livens chest.*—This component of the accessories set is shipped "as is" without outer box.

b. Blasting machine.—Each blasting machine is packed separately in a wooden box with the following approximate outside dimensions and weight:

Length	inches	18¾
Width	do	9 3/16
Depth	do	7¾
Weight of box, packed	pounds	27
Displacement of box	cubic feet	0.77

c. Wire reel.—The wire reel is packed in a wooden box of the following approximate outside dimensions and weight:

Length	inches	31⅞
Width	do	13
Depth	do	13¾
Weight, packed	pounds	35
Displacement of box	cubic feet	3.3

d. Other items.—Any commercial packing that will insure delivery in good condition may be used.

e. Complete set.—The complete set of accessories when packed weighs approximately 280 pounds and has a total displacement of 14.3 cubic feet.

f. Marking.—All shipping containers are marked as prescribed by the latest issue of United States Army Specification 100–2 and by the Interstate Commerce Commission regulations.

g. Shipping name.—Gun mount parts, N. O. I. B. N.

27. Care and storage.—*a. General.*—The latest approved types of magazines used for the storage of explosives and ammunition at ordnance establishments are designated as explosive magazines, smokeless powder magazines, primer and fuze magazines, ammunition magazines, and warehouses. These magazines are described in detail on drawings and in specifications of the Ordnance Department. Storing together any two substances, one of which will "step up" or explode the other, is forbidden. Thus detonators must not be stored with high explosives, smokeless powder, or with adapters and bursters. The magazines should be located to conform to the American Table of Distances, published by the Institute of Explosives

Makers. Magazines containing explosives should not be located adjacent to warehouses containing filled chemical shell.

b. Chemical munitions.—For the purpose of storage, chemical munitions are divided into four groups according to the nature of the fillings. Shell filled with both phosgene (CG) and sulfur trioxide-chlorosulfonic acid smoke mixture (FS) are classed as group B munitions, and should be stored in accordance with instructions given in Ordnance Safety Manual Form No. 7224, part IV, section XXIII.

c. Fuze MI.—Fuzes will be stored in primer and fuze magazines constructed in accordance with Ordnance Department specifications and as outlined in Ordnance Safety Manual Form No. 7224, part I, section IV. The safety rules governing the care, maintenance, handling, and storage of this class of explosives will be observed.

d. Burster tube MI.—The storage requirements for the burster tube and adapter are the same as for fuzes.

e. Propelling charge MIII.—The construction of the magazines used for storing propelling charges will conform to the Ordnance Department specifications for smokeless powder magazines as outlined in Ordnance Safety Manual Form No. 7224, part I, section IV. Since smokeless powder requires good protection against moisture and high temperature and is a fire hazard, the magazines vary considerably in construction details from the other standard magazines. Safety rules and regulations governing handling, storage, and care and maintenance of the buildings, prescribed for smokeless powder magazines, will be observed.

f. Blasting machine.—The blasting machine should be stored in a dry, cool place. It should not be thrown about carelessly or exposed to wet weather. The bearings and gears should be kept lightly oiled. No oil should be allowed on the commutator, which is the small copper-covered wheel on the end of the armature shaft. Graphite may be used for lubrication. The two slots cut in the copper part of the commutator must be clean and free from any material that might cause a short circuit. The copper brushes should be clean and bear firmly on the commutator, and the circuit-breaking contacts must be bright and clean.

g. Galvanometer.—Some parts of the galvanometer are of delicate construction, necessitating that the instrument be handled with care and kept dry.

SECTION VII

CARE AND MAINTENANCE

28. General.—Although the Livens projector is fired only once per emplacement, the weapon may often be salvaged and used again until it has become unsafe or rendered useless by distortion resulting from firing.

29. Procedure.—The bore of the Livens projector barrel should be kept clean and free of rust, and protected from corrosion by a coat of some rust-preventive compound. The muzzle cover should be tied on except when the projector is in use. The outside of the barrel and base plate should be kept well painted with an acidproof black paint as a protection against rust.

SECTION VIII

TRANSPORTATION

30. Data.—The following table shows the number of components of the Livens projector that can be transported by truck, trailer, four-man handcart, and by one man. The approximate weight of the component, together with its displacement in cubic feet, is also shown.

Transportation table

Component	Approximate weight (pounds)	Displacement (cubic feet)	2½-ton truck	1½-ton truck	1-ton trailer	4-man hand cart	Man
Barrel MI (loose)	104	3. 83	46	28	18	4	1
Base plate MI (loose)	28	. 65	178	107	71	8	2
Base plate MI (boxed)	185	4. 9	130	80	50	5	------
Shell, filled (boxed)	83	1. 5	60	36	24	3	1
Shell, filled (loose)	61	. 8	81	49	32	4	1
Charge MIII (boxed)	56	2. 2	356	212	144	------	------
Charge MIII (loose)	8	. 5	579	345	234	------	4
Livens projector, complete with ammunition	213	6. 83	25	15	10	3	⅓

APPENDIX

LIST OF REFERENCES

FM 3–5, Tactics of Chemical Warfare.
FM 3–10, Examination for Gunners.
FM 3–20, Organization and Employment of Chemical Weapons Troops.
FS 3–2, Effects of Weather, Terrain, Weapons and Tactics.
FS 3–9, The Livens Projector, MI.
Chemical Warfare Service Storage Catalog.
Standard Nomenclature and Price List of Chemical Warfare Material.

[A. G. 062.11 (6–1–42).]

BY ORDER OF THE SECRETARY OF WAR:

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Chief of Staff.

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